A NEW TRANSMUTED PROBABILITY MODEL: PROPERTIES AND APPLICATIONS

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Abstract

In this article, we introduced a new three parameter continuous probability model by extending a two parameter log-logistic distribution using the quadratic rank transmutation map technique. We provide a comprehensive description of the statistical properties of the newly introduced model. Robust measures of skewness and kurtosis of the proposed model have also been derived along with the moment generating function, characteristic function, reliability function and hazard rate function of the proposed model. The estimation of the model parameters is performed by maximum likelihood method followed by a Monte Carlo simulation procedure. The applicability of this distribution to modeling real life data is illustrated by two real life examples and the results of comparison to base distribution in modeling the data are also exhibited.

Keywords: Transmuted Probability Model, Survival Analysis, Reliability Measures, Monte Carlo Simulation.

1. Introduction

The quality of procedures that are put to use in a statistical analysis relies greatly upon the assumed probability model or distribution. As a consequence of this, significant effort has been directed over the course of history towards the development of large classes of standard distributions along with relevant statistical methodologies. These happen to be designed for serving as models for a wide variety of real-world phenomena. However, many important situations exist where real data does not follow any of the classical or standard models. In the work that follows, we have obtained a three-parameter Generalized Log-Logistic Distribution (GLLD) by utilizing the Quadratic Rank Transmutation Map (QRTM) technique proposed by Shaw and Buckley [1]. The field of transmutation has seen a lot of research recently. Ashour and Eltehiwy [2] introduced a new generalized distribution of the exponentiated modified Weibull distribution using the transmutation technique. Aryal et al. [3] introduced the transmuted extreme value distribution. Merovci et al. [4, 5] studied the transmuted Lindley and Rayleigh distributions. Now we will study the three-parameter Generalized Log-Logistic Distribution (GLLD) and obtain and understand its different characteristics as well as its structural properties.

According to the Quadratic Rank Transmutation Map (QRTM) technique for generalization, the cumulative distribution function (CDF) must satisfy the relationship:

$$F_t(x) = (1+\lambda)F_b(x) - \lambda[F_b(x)]^2 \quad (1)$$

which upon differentiation yields,

$$f_t(x) = f_b(x)[1+\lambda-2\lambda F_b(x)] \quad (2)$$

where $f_b(x)$and $f_t(x)$ are the probability density functions corresponding to $F_b(x)$ and